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1988

Monitoring Report On The Glanbrook Landfill Site

1988

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TERRAQUA INVESTIGATIONS LTD.

41 PRINCESS STREET, EAST, WATERLOO, ONTARIO N2J 2H6
(519) 888-7892 FAX (519) 888-6006

PROPOSAL FOR:

EVALUATION OF THE GLANBROOK LANDFILL SITE 1988 MONITORING PROGRAM

Submitted to:

Regional Municipality of Hamilton-Wentworth
Department of Engineering
Sixth Floor, City Hall
71 Main Street West
HAMILTON, Ontario
L8N 3T4

by

TERRAQUA INVESTIGATIONS LTD.

R. BLACKPORT

Reference No. PTA8894a

November 18, 1988

TABLE OF CONTENTS

		Page
1.0	**INTRODUCTION**	1
	1.1 BACKGROUND	1
	1.2 TERMS OF REFERENCE	1
2.0	**STUDY METHODOLOGY**	3
	2.1 BACKGROUND REVIEW	3
	2.2 DATA ANALYSIS	3
3.0	**REPORT PREPARATION**	4
4.0	**WORK PLAN AND SCHEDULE**	6
5.0	**STUDY TEAM AND RELEVANT EXPERIENCE**	7
	5.1 CORPORATE EXPERIENCE	7
	5.2 STUDY TEAM AND EXPERIENCE	8
6.0	**PRICE PROPOSAL**	13
	6.1 COST ESTIMATE	13
	6.2 TERMS AND CONDITIONS	13

APPENDIX A - Curricula Vitae

APPENDIX B - Company Profile

APPENDIX C - Example Data Base

LIST OF TABLES

		Page
Table 1	Sample Table of Contents	- 5
Table 2	Cost Estimate	15

1.0 INTRODUCTION

1.1 BACKGROUND

The Regional Municipality of Hamilton-Wentworth presently undertakes a surface water and groundwater monitoring program at the Glanbrook Landfill Site. The Region maintains a record of analytical data which is generally collected on a semi-annual basis. The updated data are presently reviewed annually by a qualified hydrogeologist. The review entails the assessment of monitoring program results, and the presentation of recommendations for future monitoring based on the overall data collected to date.

1.2 TERMS OF REFERENCE

The Terms of Reference, as stated in the Request for Proposal dated October 20, 1988, are as follows:

> "1988 Annual Operational Monitoring Report for the Regional Landfill Site in Glanbrook.". This activity requires the preparation of an annual report based on the 1988 monitoring program which the Region conducted at its' landfill site in Glanbrook. The final report will review and summarize significant findings, provide conclusions, and make recommendations to ensure that landfilling operations continue in an environmentally acceptable manner, to the satisfaction of the Ministry of the Environment (MOE) and in conformance with applicable environmental standards.

Our understanding of this is that the review should include:

1) a review of previous reports and data
2) a review of analytical results obtained during 1988
3) a review of hydrogeological data as supplied by the Region
4) a visit to the site to observe first hand the location and status of all monitoring points

Upon completion of the review the following should be done:

1) Make recommendations if any, as to proposed changes to monitoring procedures presently in place.
2) Make recommendations as to the necessity for additional monitoring installations, including proposed locations where appropriate.
3) Inform Regional staff of any concerns arising from the review of analytical data.
4) Prepare a report capable of standing on its own when reviewed by a third party, such as MOE.

2.0 STUDY METHODOLOGY

2.1 BACKGROUND REVIEW

Prior to data analyses and interpretation of the 1988 analytical data, a review of the previous data, physical setting, geological information and hydrogeological information will be performed in order to properly interpret the 1988 data. All applicable information utilized in the review will be included in a final report to allow a third party review a complete understanding of the site.

2.2 DATA ANALYSES

A general discussion of the previous results will be presented to examine the general trends, evidence of landfill contamination and the rationale for the present monitoring program. Data from the present monitoring program will be presented and analysed using a computer data base by plotting graphs of concentration versus date for the various chemical parameters in order to more easily observe any trends. Data will be plotted over the last few years to examine trends. Examples of the plots used for another landfill monitoring program are shown in Appendix C.

Results will be compared to Ontario Drinking Water Objectives and will be grouped together with respect to upgradient wells, downgradient wells and surface waters.

3.0 REPORT PREPARATION

Upon completion of the data review and analyses a report will be prepared following the Table of Contents shown in Table 1. If the format of the previous years report is recommended by the committee our report could be prepared in the same manner. The report will be capable of standing on its own. This means that a third party, such as the MOE, will be able to read the report and understand the site history, geology, hydrogeology, monitoring program and rationale for the monitoring program as well as the present results.

Five draft copies of the report will be Submitted to the Regional Municipality of Hamilton-Wentworth for review and comment if so desired. Eight copies of the final report will be submitted to the Region.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 BACKGROUND

1.2 TERMS OF REFERENCE

1.3 DOCUMENTS REVIEWED

2.0 SITE DESCRIPTION

2.1 BACKGROUND

2.2 PHYSICAL SETTING

3.0 MONITORING PROGRAM

3.1 EXISTING MONITORING PROGRAM

3.2 SAMPLING RESULTS

4.0 RESULTS OF THE PRESENT MONITORING

5.0 CONCLUSIONS AND RECOMMENDATIONS

APPENDIX A - Well Logs

APPENDIX B - Results of the Present Monitoring Program

APPENDIX C - Graphs of Analytical Results

TABLE 1

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4.0 WORK PLAN AND SCHEDULE

Upon authorization to proceed, a meeting will be held with appropriate personnel to obtain the necessary background information. A site visit will take place at this time. The anticipated timing of the meeting is within two weeks of authorization to proceed.

A draft report will be prepared within eight weeks of authorization to proceed. When comments have been received from the Region a final report will be prepared within two weeks of receipt of these comments. If a draft report is not necessary, the final report will be submitted eight weeks after authorization to proceed.

5.0 RELEVANT EXPERIENCE

5.1 CORPORATE EXPERIENCE

Terraqua Investigations Ltd. (Terraqua) was incorporated in 1978 to provide specialized services in the field of hydrogeology. Terraqua has been involved in a number of monitoring reviews of landfill sites in southern Ontario for various Townships, Counties and Regional Municipalities. Terraqua has also been involved in many studies of contaminant migration in fractured rock.

Terraqua has also been involved in a wide variety of contaminant studies ranging from studies on reactive mine tailings in northern Quebec, Saskatchewan and California to investigation of organic spills such as PCB's, TCE and gasoline in Saskatchewan, Ontario and New Brunswick, Pennsylvania and Michigan.

Staff of Terraqua have also been involved in numerous hydrogeologic reviews of groundwater contaminated sites for the Ontario Ministry of the Environment (MOE). The most recent study was a hydrogeological and hydrogeochemical assessment of the Uniroyal chemical company plant site in Elmira, Ontario. The site produced most known pesticides as well as dioxin and numerous fertilizer chemicals over its 50 year history. As a result of studies such as this for the MOE, Terraqua has developed a good working relationship with the MOE, and also has a sound understanding of various acts related to groundwater pollution and waste management, such as the Ontario Water Resources Act and the

Environmental Protection Act.

Terraqua is a small company but maintains close associations with various other firms specialized in waste management, cleanup, engineering design and environmental assessment. We feel this approach optimizes the cost benefit to the client.

Our company structure is such that we commit key people full-time to hydrogeological studies of the type presented in this proposal. A senior hydrogeologist sets the budget, manages the project and is involved in much work, thereby keeping close control over each project.

A detailed company profile is presented in Appendix B.

5.2 STUDY TEAM

Ray Blackport M.Sc., Principal, Consulting Hydrogeologist

Mr. Blackport, who has been a principal of Terraqua since it was incorporated in 1978, has extensive experience in landfill monitoring studies and contaminant hydrogeology studies. He will act as project manager and senior hydrogeologist for the study.

Relevant recent hydrogeological monitoring studies which Mr. Blackport has acted as project manager or a senior hydrogeologist include:

* Annual monitoring review of active landfill sites within the Region of Peel for 1986, 1987, 1988. Analyses of yearly data collected and recommendations for future monitoring at

three Regional landfills have been performed annually. One site required further monitoring well installation due to potential problems related to an adjacent salt storage area and Mr. Blackport was responsible for this work also.

* Annual monitoring review of the Essex County Landfill (No.1) for the County of Essex. Terraqua was responsible for implementation of a detail monitoring program at the landfill and is now responsible for the monitoring program for the next four years.
* Annual sampling and monitoring review of the Minto Township Landfill. Mr. Blackport was responsible for the hydrogeological investigation at the active landfill and proposed expansion area and is now conducting the annual monitoring program and review of the landfill.
* Annual sampling program and monitoring review of the Centre Wellington Landfill near Fergus, Ontario. An assessment of the site closure program was made and a monitoring program was recommended which is now being conducted annually by Terraqua.
* A hydrogeological investigation of a proposed landfill in a large quarry at Acton, Ontario. A detailed hydrogeological investigation is currently being completed for submission to an Environmental Assessment Board under the Environmental Protection Act, Terraqua and Mr. Blackport are part of a study team assessing the hydrogeological setting of this quarry located in fractured dolomites and shales.
* A hydrogeological and geochemical review of the Uniroyal

Chemical Plant site in Elmira, Ontario, for the Ontario Ministry of the Environment. An assessment of the site geological and hydrogeological conditions at a chemical plant, which manufactured most known pesticides, was conducted for MOE. Concerns with respect to the migration of contaminants to local municipal water supplies were addressed. Various pumping scenarios, pumping tests, hydrostratigraphic information, and chemical data were examined to assess the potential for contamination of the water supply aquifer underlying the site.

* A hydrogeological investigation at a closed industrial waste landfill, Hamilton, Ontario. Mr. Blackport was part of a study team with the University of Waterloo, assessing contaminant migration in fractured rock from a landfill containing various quantities of waste oils, sludges and other industrial and domestic refuse. He was responsible for the assessment of the physical hydrogeology of the study area, as part of an overall study to determine potential health-related impacts from the landfill.

* A hydrogeological investigation of a potentially hazardous waste site containing cyanide, Niagara Falls, Ontario. A study was conducted for the Ministry of the Environment, Niagara River Toxics Committee, to assess the potentially hazardous waste sites on the Canadian side of the Niagara River. The study included an assessment of the extent of waste existing on site, site geology, groundwater flow directions and the extent of downward contaminant

migration.

* A hydrogeological investigation of the River Road Landfill, Welland, Ontario. A study was conducted for the Ontario Ministry of the Environment, Niagara River Toxics Committee, to assess the potential contaminant migration of waste acids from an acid pit located on the property of a steel company. The site is underlain by glaciolacustrine silts and clays and the Halton till. A follow up study was done for the owners of the landfill, Atlas Specialty Steels, to develop a long term monitoring program for the site.
* A hydrogeological investigation of the Breslube Enterprises Limited Re-refinery plant site, Breslau, Ontario. The study involved defining the geological and hydrogeological characteristics of the site, and assessing the existing and potential contaminant migration from the present plant operation and former waste oil lagoons, as well as the potential for contamination of several regional water supply wells.
* A hydrogeological investigation of the Budd Canada property and sludge lagoon area, Kitchener, Ontario. A hydrogeological investigation was performed to assess the hydrogeological setting, and the potential impact on the groundwater regime, from sludges and waste soils potentially containing PCB's and heavy metals.
* A hydrogeological investigation of Shamrock Chemicals Ltd. Plant Site, Port Stanley, Ontario. A hydrogeological investigation was carried out to comply with a Control Order

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issued by the Ministry of the Environment. The investigation was conducted to assess site geological and hydrogeological conditions, the extent of contamination, and the potential for off-site migration of various chemicals and sulfuric acid spilled on-site.

Ms. Brenda Boyle B.A.Sc. Geological Engineer

Ms. Boyle will be responsible for data compilation and analyses. She has been involved with a number of the studies, previously described with Mr. Blackport's section on experience, including but not limited to the following projects:

* Annual monitoring review, Region of Peel Landfill sites.
* A hydrogeological investigation and monitoring review, Minto Township Landfill.
* A hydrogeological investigation and recommendations for monitoring for the Norwich Landfill site (for MOE).
* A hydrogeological investigation of the Algoma slag dump (containing waste oil, acid, PCB's, and coal tar) in Sault Ste. Marie (as part of a study team for MOE).

6.0 PRICE PROPOSAL

6.1 COST ESTIMATE

Costs will be controlled, based on hourly and disbursement budgets as outlined in Table 2. The expenditures are monitored on a weekly basis by the project manager to allow tight control of expenditure, and permit any potential cost overruns or schedule slippage to be easily determined.

Time sheets and disbursements are submitted to the office manager for processing on our own computerized spreadsheet. Each project file is coded separately and printouts of the updated costs associated with each project are given to the project manager. The project manager assesses the actual cost with the orginal cost estimate to determine if any potential cost overruns or savings exist.

Professional services are based on hourly rates for Terraqua staff. The present billing rates for personnel associated with this project are as follows:

R. Blackport (Sr)	$65.00/hour	$520.00/day
B. Boyle (Int)	$45.00/hour	$360.00/day
Technical Support	$25.00/hour	$200.00/day

6.2 TERMS AND CONDITIONS

The proposed terms and conditions of the contract are on an at cost basis plus fixed fees, with payments based on monthly invoices for actual services and disbursements.

The terms of payment will be net 30 days with interest charged at 1.5% per month on overdue accounts. If payment is not received in 75 days, work may be halted until such time as the account is brought up to date. If the Region has specified terms that are applied to this type of contract they will be reviewed and if reasonable, will be accepted by Terraqua prior to authorization to proceed.

DAILY BREAKDOWN	SR (RJB)	INT (BJB)	SUPPORT STAFF	
Regional Office and Site Visit	0.5			
Background Data Review		1		
Data Reduction		0.5		
Analyses and Report Preparation	0.5	1.5	1	
	1.0	3.0	1	
Total Fees	520	1080	200	$ 1800.00
Disbursements				
Report Copying				120.00
TOTAL COST				$ 1920.00

TABLE 2

COST ESTIMATE

APPENDIX A

Curricula Vitae

RAY BLACKPORT, M.Sc.
Principal
Hydrogeologist

EDUCATION:

1980 **University of Waterloo**
M.Sc. (Hydrogeology)

Thesis: A Hydrogeologic Response Model For Excavations In Large Multiple Aquifer Systems

1976 **University of Waterloo**
B.Sc. (Earth Science)

Thesis: Application Of A Sensitivity Analysis Procedure For Determining Relative Hydraulic Conductivities In A Heterogeneous Groundwater Flow System

PROFESSIONAL HISTORY:

1978-Present **Hydrogeologist**
Principal, Terraqua Investigations Ltd.

1977-1978 **Teaching Assistant**
Earth Science Department, University of Waterloo, for Second year Geochemistry and Third year Geomorphology

1977-1978 **Independent Hydrogeologist**

1976 **Hydrogeologist**
Gartner Lee Associates Ltd.

1975 **Hydrogeologist**
Waterloo Research Institute, University of Waterloo

Mr. Blackport has been involved in conducting hydrogeological studies for over 12 years and has extensive field experience. He also has a strong technical background with emphasis on geology and computer modelling. He has carried many hydrogeological projects from initiation to the final product and has been a liason between many clients and government agencies such as the Ontario Ministry of the Environment.

Representative Projects in which Mr. Blackport has been the principal hydrogeologist responsible for all aspects of the hydrogeology study from implementation through to report preparation are summarized below.

* A hydrogeological evaluation of the Mattabi Mines Tailings Site, Ignace, Ontario (in progress)
  Client: Mattabi Mines/Noranda Research Centre

* A hydrogeological evaluation the Budd Canada Property (sludge lagoon/contaminated soils), Kitchener, Ontario
  Client: Budd Canada

* Assessment of hydrogeology and site closure plans at the Centre Wellington Landfill Site, Fergus, Ontario
  Client: Triton Engineering Services Limited

* Annual monitoring review of Region of Peel landfill sites - 1986, 1987 (on-going)
  Client: Regional Municipality of Peel

* A hydrogeological investigation of the River Road Landfill, Welland, Ontario
  Client: Atlas Specialty Steel

* A hydrogeological investigation of the Minto Township Landfill, and proposed expansion area Wellington County
  Client: Minto Township, Harriston, Palmerston, Clifford Landfill Committee/Triton Engineering Services Limited

* A hydrogeological investigation of Shamrock Chemicals Ltd., Plant Site, Port Stanley, Ontario
  Client: Shamrock Chemicals Ltd.

* A hydrogeological investigation of Breslube Enterprises Ltd. Re-refinery Plant Site, Breslau, Ontario
  Client: Breslube Enterprises Ltd.

* A hydrogeological review of the Fort Erie (Bridge Street) Landfill, and proposed site expansion Fort Erie, Ontario
  Client: Ontario Ministry of the Environment

* A preliminary hydrogeological investigation of a potentially hazardous waste site containing cyanide, Niagara Falls, Ontario
  Client: Ontario Ministry of the Environment

* A hydrogeological investigation of the Waite-Amulet Mine Tailings, Noranda, Quebec
  Client: Centre de Recherche Noranda

MS. BRENDA J. BOYLE BASc.

EDUCATION:

1982-1987	**University of Waterloo** BASc. degree in the co-operative Geological Engineering program.

PROFESSIONAL HISTORY:

1987-Present	**Geological Engineer** Terraqua Investigations Ltd.
Jan-Apr 1986	**Production Research Technician** Petro-Canada Resources Inc., Calgary, Alberta - performed core flood tests to determine the effects of fresh water on sample permeability - used scanning electron microscope and KEVEX energy dispersive X-ray - applied chemical geothermometry to extensive produced-water data in order to estimate downhole temperatures during enhanced recovery
May-Aug 1986 May-Aug 1985	**Geological Research Technician** University of Waterloo, Waterloo, Ontario - tested strength and compaction properties of granular waste halite to be backfilled in salt mine rooms - extracted clay minerals from dolomite and limestone core, prepared slides for X-ray diffraction, analysed XRD traces, used SEM, KEVEX
Sept-Dec 1984	**Geological Assistant** Gulf Canada Resources Inc., Calgary, Alberta
Jan-Apr 1984	**Assistant to Co-Ordinator** Energy, Mines and Resources Canada, Ottawa, Ontario

Various projects with which Ms. Boyle has been involved are summarized below.

* Hydrogeological investigation at the Algoma Steel Slag Area in Sault Ste. Marie, Ontario. Supervised drilling and monitoring well installations at 30 locations; involved in day to day project management, data analysis and report preparation (1988)
  Client: Ontario Ministry of the Environment

* Hydrogelogical assessment of the closed Norwich Landfill in Norwich, Ontario. Project manager; supervised all aspects of field program, including drilling and monitoring well installation, collection of samples, reponse testing; analysed data and prepared report (1988)
  Client: Ontario Ministry of the Environment

* Evaluation of a water supply for the Village of Drumbo, Ontario. Supervised several long and short-term pumping tests, analysed data and prepared report regarding groundwater availablility in the Drumbo area (1988)
  Client: K. Smart Associates Limited

* Development of water supplies for two proposed Senior Citizen Housing Projects in the Villages of Burford and Drumbo, Ontario. Supervised well drilling and pumping tests at both locations (1988)
  Client: K. Smart Associates Limited

* Evaluation of a water supply for a Conservation area in Belfountain, Ontario, for the Credit River Valley Conservation Authority. Assessed groundwater quantity and quality of overburden and bedrock (1988)
  Client: Triton Engineering Services Limited

* Development of a water supply for a proposed fish farm in Norwich, Ontario. Conducted several long-term pumping tests, assessed results, and prepared report and application for permit to take water (1988)
  Client: J. and C. Vande Ven

* An inventory of water wells along the right-of-way of a new 550 kV transmission line from the Bruce Nuclear Power Development to the Longwood Transformer Station. Background water quality and quantity of domestic water wells along the right-of-way were assessed prior to construction of the line, in order to obtain baseline groundwater information which would aid in constructinng replacement wells, and settling future interference or contamination claims by owners. Project manager, field supervisor.(1988)
  Client: Ontario Hydro

* Hydrogeological investigation at the Budd Canada plant in Kitchener, Ontario regarding the development of a stormwater infiltration basin. Involved in all aspects of the project including drilling and monitoring well installation, water sampling, well testing, compilation and analysis of data and report preparation (1987)
  Client: Budd Canada

* Hydrogeological assessment of a sludge lagoon at the Budd Canada plant in Kitchener, Ontario. Involved in general aspects of the field program (1987)
  Client: Budd Canada

* Hydrogeological investigation of the proposed expansion area at the Minto Township Landfill, Wellington County. Involved in drilling and monitoring well installation program, sampling and report preparation (1987)
  Client: Minto Township; Harriston, Palmerston, Clifford Landfill Committee/Triton Engineering Services Limited

* Assessment of a water supply for a proposed subdivision in Bright, Ontario. Conducted pumping tests on an existing well, assessed water quality (1987)
  Client: D. Wagner

* Baseline hydrogeological assessment for the Credit River Pines Estate development near Erin, Ontario. Assessed groundwater availability and potential for septic system contamination of the Credit River. Involved in field program and report preparation (1987)
  Client: England Naylor Engineering Ltd.

APPENDIX B

Company Profile

TERRAQUA INVESTIGATIONS LTD.

Terraqua Investigations Ltd. was incorporated in 1978 to provide specialized services in the field of hydrogeology. Personnel involved with Terraqua Investigations Ltd. are strongly field-oriented yet have a high level of technical and - academic qualifications to integrate with the practical field experience. Most personnel associated with the firm also have a strong computer modelling background, ranging from groundwater flow modelling to contaminant transport and geochemical modelling.

Terraqua Investigations Ltd. has provided hydrogeological input on a variety of projects for a diverse range of clients such as environmental planners, consulting engineers, most levels of government, and local citizen and ratepayer groups. The firm and associated personnel have also had considerable involvement in hydrogeological studies with the Institute for Groundwater Research at the University of Waterloo. This combination of experience enables the firm to understand the needs of various clients and also maintain state-of-the-art expertise in hydrogeological investigations.

Terraqua Investigations Ltd. also has a close association with personnel and consulting firms in fields associated with many aspects of environmental studies and engineering studies. These include environmental planning, engineering design, waste management, and waste stabilization.

Company services, experience and curricula vitae of key personnel are outlined in the following sections.

TERRAQUA INVESTIGATIONS LTD.

Hydrogeological Services

Baseline Groundwater Investigations and Resource Evaluation

* drilling supervision
* groundwater instrumentation and interpretation
* water quality characterization and interpretation
* aquifer testing and water supply evaluation

Contaminant Hydrogeology

* drilling supervision and soil sampling
* designing and implementation of groundwater monitoring networks
* designing and implementation of water quality sampling programs
* assessment of contaminant migration
* expert testimony

Hydrogeological Review and Assessment

* review and assessment of site specific hydrogeological studies
* background reviews of regional groundwater studies
* literature reviews of all aspects of hydrogeology

Computer Modelling

* modelling groundwater flow systems
* contaminant transport modelling
* excavation dewatering and well field optimization
* geochemical modelling

Geological Services

Geophysical Investigations

Aggregate Studies

Geological Mapping

RECENT ASSIGNMENTS - Similar Projects

Although most assignments are not specifically related to Waste Management Master Plans, they are related to landfill investigations, particularly contaminant migration and landfill expansion and/or closure. As a result, Terraqua has a solid background in field investigations and assessments of potential landfill contamination in various geological settings. In addition, several projects in progress, particularly a proposed large private landfill, will be subjected to a full Environmental Assessment Board hearing in the near future.

* Preliminary hydrogeological investigation of proposed landfill sites in Proudfoot and Bethune Townships, as part of a Waste Management Master Plan
  Client: The Town of Kearney/BRY-CO Engineering

* A hydrogeological evaluation of a large proposed landfill site at the Acton Quarry in Acton, Ontario, in preparation for an Environmental Assessment Board Hearing (in progress)
  Client: Reclamation Systems Inc.

* A hydrogeological investigation of an existing landfill site in Essex County (in progress)
  Client: The County of Essex/Gore and Storrie Limited

* A hydrogeological investigation of the Minto Township Landfill, and proposed expansion area, Wellington County
  Client: Minto Township, Harriston, Palmerston, Clifford Landfill Committee/Triton Engineering Services Limited

* A hydrogeological investigation of the Algoma Steel Slag Dump site in Sault Ste. Marie (in progress)
  Client: Ontario Ministry of the Environment

* A hydrogeological evaluation of the Norwich Landfill and development of a long term monitoring program, Norwich, Ontario (in progress)
  Client: Ontario Ministry of the Environment

* Assessment of hydrogeology and site closure plans at the Centre Wellington Landfill Site, Fergus, Ontario
  Client: Triton Engineering Services Limited

* A hydrogeological investigation of proposed candidate landfill sites within the Town of Oakville
  Client: Gore & Storrie Limited/Town of Oakville

* A hydrogeological investigation at a closed industrial waste landfill site located on fractured dolomite and shale, Hamilton, Ontario
  Client: University of Waterloo

BASELINE GROUNDWATER INVESTIGATION AND RESOURCE EVALUATION

Terraqua Investigations Ltd., has the expertise to perform detailed hydrogeological site investigations and data analyses. This includes impact assessment of waste disposal sites, mine tailings, excavation dewatering as well as general assessments of groundwater flow systems and groundwater resource evaluation. Terraqua Investigations Ltd. has been involved in many field studies including:

* A hydrogeological evaluation of a proposed gravel pit in Puslinch Township.

* Water supply evaluation for various aqua culture (fish farms) projects.

* Evaluation of water supply potential for proposed subdivisions near Elora, Erin, Hillsburgh and Bright, Ontario.

* Evaluation of groundwater and contaminant velocities in fractured shales, Clarkson, Ontario (ongoing).

* A hydrogeological investigation of a reactive sulphide tailings area, near Rouyn, Quebec.

* A hydrogeological and geological investigation of a proposed subdivision, Caledon, Ontario

* A hydrogeological investigation of a proposed landfill site within the Town of Oakville

* A hydrogeological investigation of the impact of a proposed highway corridor on a large wetland area near Bradford, Ontario.

* Assessing the potential for water supply of a proposed mountain subdivision near Merritt, British Columbia.

* A hydrogeological field investigation and data analyses of four proposed gold tailing sites in North Central California.

* Hydrogeological investigation of a proposed subdivision with septic systems for an Ontario Municipal Board Hearing, Waterloo, Ontario.

* Geological and hydrogeological investigation of a potential sewage effluent disposal site, New Hamburg, Ontario.

CONTAMINANT HYDROGEOLOGY

Terraqua Investigations Ltd. has the expertise to investigate existing groundwater contamination problems with respect to: source of contamination, extent of groundwater contamination, future impact on the groundwater regime, and assessing possible remedial measures. This includes assessment of on-site and off-site impacts of mine tailings, domestic and hazardous waste disposal and industrial spills. Terraqua Investigations Ltd. has been involved in numerous field studies including:

* A hydrogeological investigation of the Galtaco Foundry Waste Disposal Site, Brantford, Ontario

* A hydrogeological investigation of Breslube Enterprises Ltd. Refinery Plant Site, Breslau, Ontario

* A hydrogeological investigation of Shamrock Chemicals Ltd., Plant Site, Port Stanley, Ontario

* A hydrogeological investigation and development of a long term monitoring program of the Minto Township landfill, Wellington County

* A preliminary hydrogeological investigation of a potentially hazardous waste site containing cyanide, Niagara Falls, Ontario

* A hydrogeological investigation and development of a long term monitoring program of the River Road Landfill Site, Atlas Specialty Steels, Welland, Ontario

* Groundwater instrumentation and monitoring of gasoline contamination of domestic wells in fractured granite rock, Fairvale, New Brunswick.

* A hydrogeological investigation at a closed industrial waste landfill site located on fractured dolomite and shale, Hamilton, Ontario.

* Field investigation of potential migration of organic compounds from a landfill located in a sandy environment, near Midland, Ontario.

* Assessment of the shallow hydrogeologic environment in the vicinity of a PCB spill, Regina, Saskatchewan.

* A hydrogeological investigation and geochemical interpretation of the West Arm Nordic Uranium Tailings, Elliot Lake, Ontario.

HYDROGEOLOGICAL REVIEW AND ASSESSMENT

Terraqua Investigations Ltd. has the expertise to review and assess site specific hydrogeological studies or detailed literature reviews on any area of hydrogeology utilizing the most up-to-date information from government agencies, scientific journals and universities. Terraqua Investigations Ltd. has been involved in numerous hydrogeologic reviews and assessments including:

* A hydrogeological review of Well Interference problems in West Flamborough Township

* A review of groundwater monitoring programs/data for landfills in the Region of Peel(1986)

* A hydrogeological and geochemical review of the Uniroyal Chemical Plant site in Elmira, Ontario

* A hydrogeological review of the Fort Erie (Bridge Street) Landfill, Fort Erie, Ontario

* A review and assessment of the hydrogeology studies of the Ontario Waste Management Corporation's proposed waste treatment sites in the Town of Milton

* Review and assessment of groundwater contamination and proposed remedial measures at the Hyde Park Landfill in Niagara Falls, New York.

* Review of hydrogeological data for a proposed hazardous waste site, and question preparation for an Environmental Assessment Board hearing, Harwich Township.

* Review of hydrogeological data of a proposed flyash disposal site, for an Environmental Assessment Board hearing, Mississauga, Ontario

* Review of hydrogeological data for a proposed landfill site, and question preparation for an Environmental Assessment Board hearing, Maple, Ontario.

* Review of hydrogeological data for a proposed expansion of a landfill site for an Environmental Assessment Board hearing, Holbrook, Ontario.

* Review of hydrological data in the vicinity of the North Bay Sanitary Landfill Site.

COMPUTER MODELLING

Terraqua Investigations Ltd. has the expertise to perform computer simulations to assess groundwater flow systems and contaminant transport within groundwater flow systems using finite element and analytical techniques. A variety of models have been developed or adapted by associates of Terraqua Investigations Ltd. as well as utilization of many existing models. Associates of Terraqua Investigations Ltd. have been involved in a variety of modelling studies including:

* Computer simulations of the groundwater flow conditions around an existing quarry, near Fort Erie, Ontario

* Development of a multi-aquifer finite element model for determining hydrogeologic responses for excavations in large multiple aquifer systems.

* Computer simulations of a proposed artificial recharge scheme at a major municipal well field, Kitchener, Ontario.

* Computer simulations of the groundwater flow system in the vicinity of a limestone quarry to determine the present and potential effects of dewatering, Southern Ontario.

* Sensitivity analysis of hydrogeological parameters in the vicinity of a proposed strip coal mine, North Dakota.

PARTIAL CLIENT LIST

Acres Consulting Services Limited, Niagara Falls, Ontario

Atlas Specialty Steels, Welland, Ontario

BBT Geotechnical Consultants Ltd., Saskatoon, Saskatchewan

Beak Consultants Ltd

Breslube Enterprises Ltd., Breslau, Ontario

Brunswick Mining and Smelting, Bathurst, New Brunswick

Canadian Environmental Law Association

Centre de Recherche Noranda

Ecoplans Ltd., Waterloo, Ontario

Galtaco Inc., Brantford, Ontario

Gartner Lee Associates, Buttonville, Ontario

Gore & Storrie Ltd., Toronto, Ontario

Institute for Groundwater Research, University of Waterloo

National Research Council of Canada, Ottawa, Ontario

Ontario Ministry of the Environment

Ontario Hydro

R. S. Guiton Associates, Vernon, British Columbia

Saskatchewan Department of the Environment

Shamrock Chemicals Ltd., London, Ontario

Smith Hoffman Associates, Guelph, Ontario

Steffen Robertson and Kirsten Ltd., Denver, Colorado

The Regional Municipality of Peel

The Township of Minto

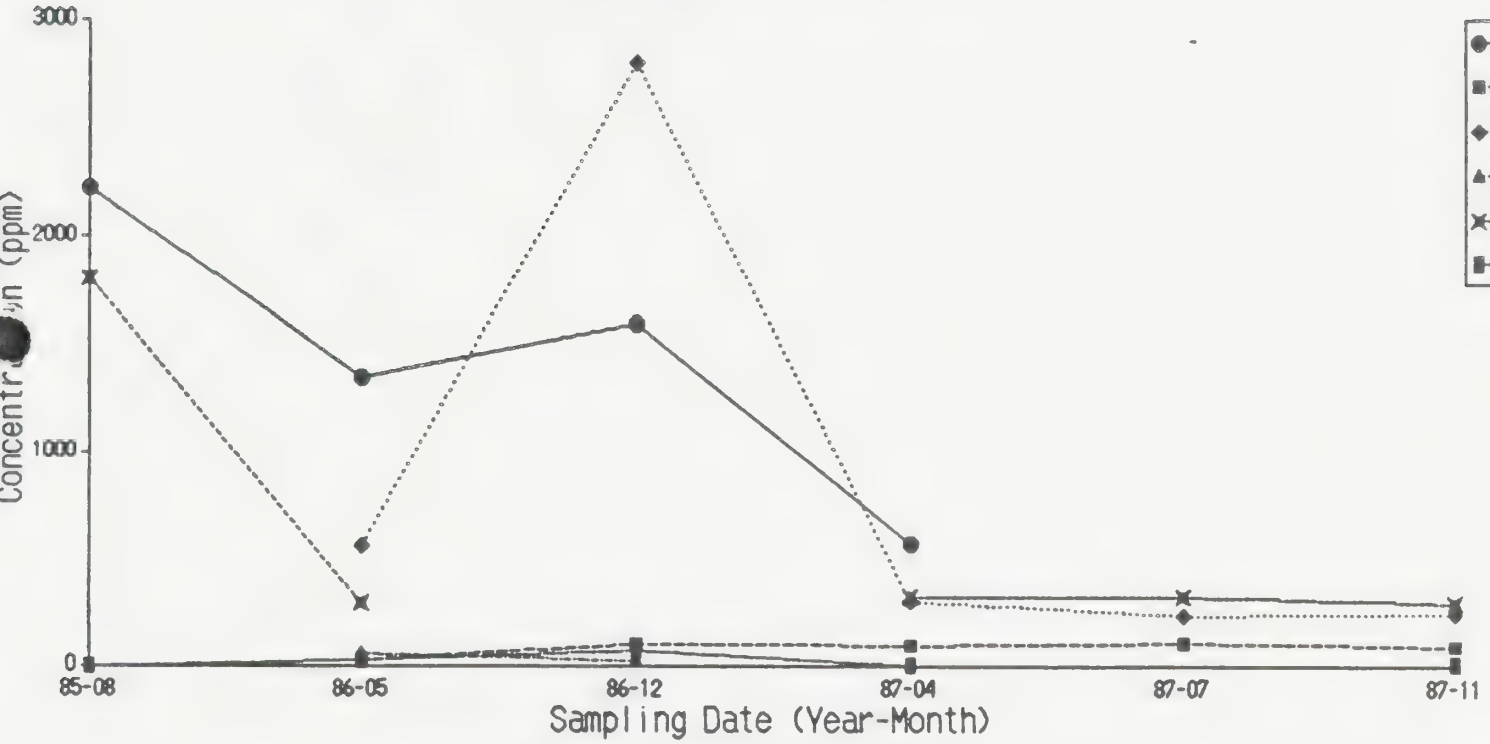
TransCanada Pipeline., Toronto, Ontario

Triton Engineering Services Limited, Orangeville, Ontario

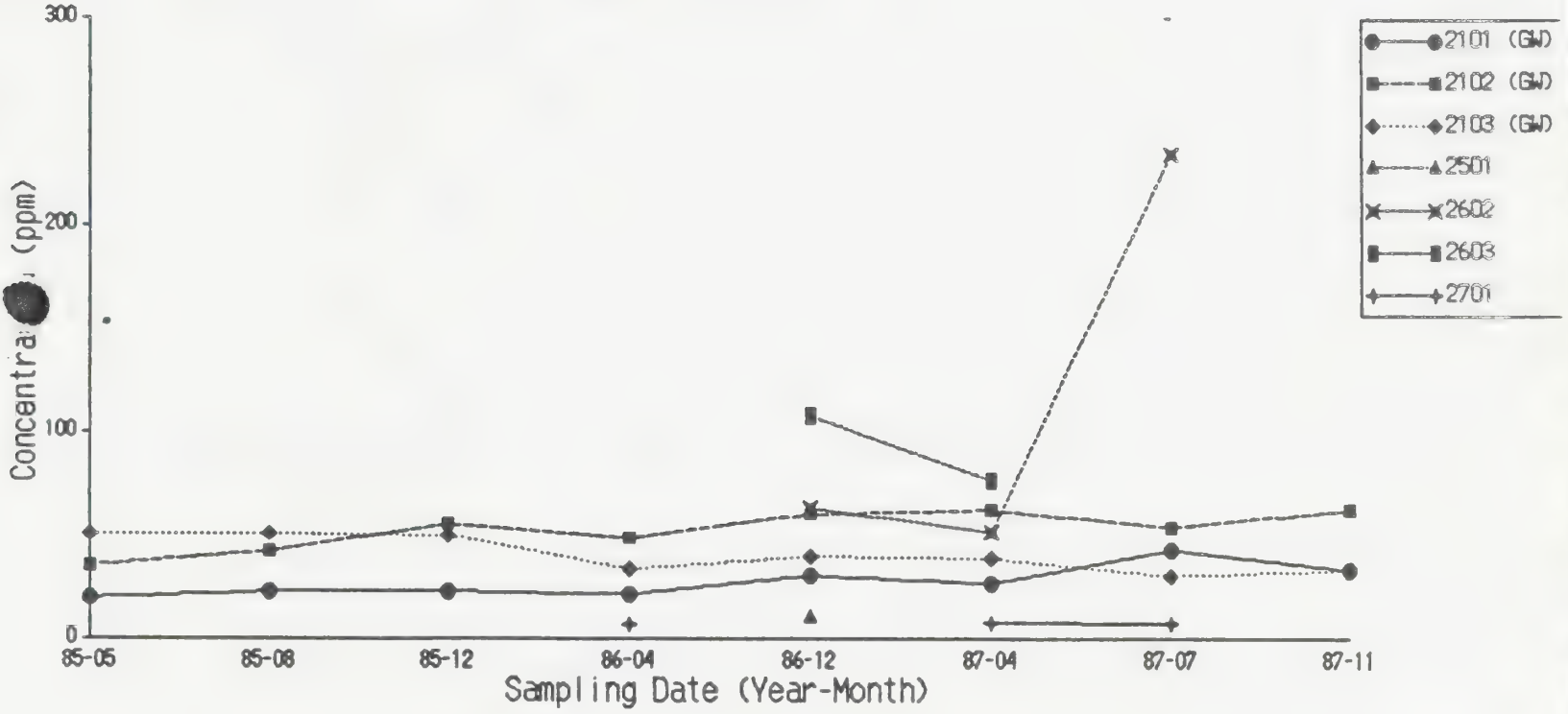
APPENDIX C

Example Data Base

SANITARY LANDFILL SITE
Water Monitoring Program
Parameter: Chloride

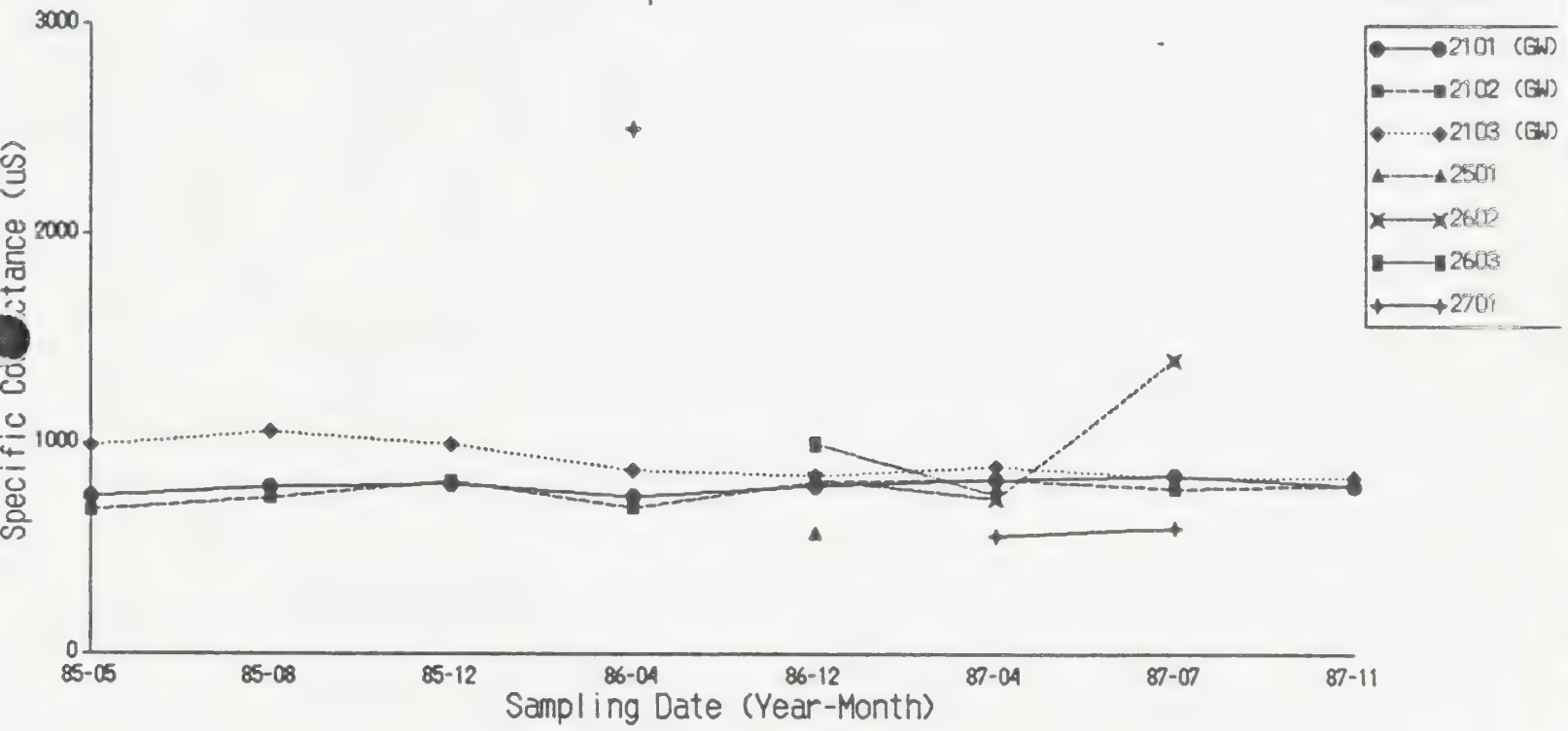


SANITARY LANDFILL SITE
Water Monitoring Program Results
Parameter: Chloride



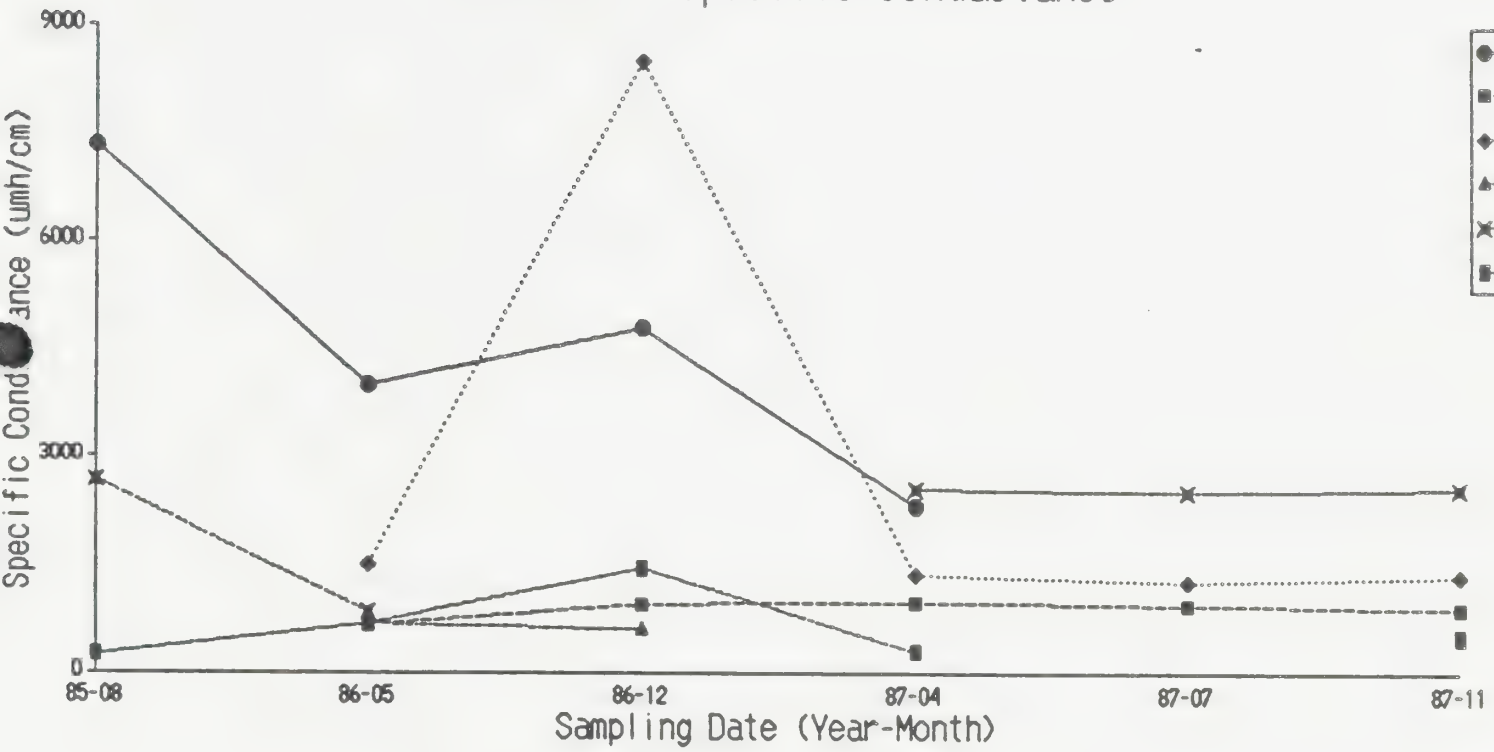
PROPOSAL - 1988

SANITARY LANDFILL SITE
Water Monitoring Program Results
Parameter: Specific Conductance



PROPOSAL - 1988

SANITARY LANDFILL SITE
Water Monitoring Program
Parameter: Specific Conductance



PROPOSAL - 1988

PROPOSAL
1988 ANNUAL OPERATIONAL MONITORING REPORT
GLANBROOK REGIONAL LANDFILL SITE
(ITEM I)

PROPOSAL - 1988

November 1988
Ref. No. 2751

CONESTOGA-ROVERS & ASSOCIATES

CRA
Consulting Engineers

FILE NO.
LETTER NO.
NOV 1 8
ENG. PLAN
RE
ANSWERED
FILED BY

CONESTOGA-ROVERS & ASSOCIATES LIMITED
651 Colby Drive,
Waterloo, Ontario, Canada N2V 1C2
(519) 884-0510

November 18, 1988

Reference No. 2751

Mr. Val Terluk, Supervisor
Solid Waste Operation
The Regional Municipality of Hamilton-Wentworth
Department of Engineering
71 Main Street West
Hamilton, Ontario
L8N 3T4

Dear Sir:

Please find the enclosed quotation for Item 1 referred to in your letter of October 20, 1988 requesting Hydrogeological Services.

If you have any questions on the enclosed, please do not hesitate to contact us.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

for John M. Petrie, M. Sc.

PH/JO/1
Encl.

TABLE OF CONTENTS

	Page
I.1.0 .....INTRODUCTION	1
I.2.0 .....OBJECTIVES	2
I.3.0 .....PROPOSED WORK PLAN	3
I.4.0 .....MEETINGS	4
I.5.0 .....COST ESTIMATE	5
I.6.0 .....PROJECT TEAM PERSONNEL	6
I.7.0 .....CORPORATE QUALIFICATIONS OF CRA	8
I.8.0 .....SUMMARY	10

I.1.0 INTRODUCTION

On October 20, 1988, Conestoga-Rovers & Associates (CRA) received from the Regional Municipality of Hamilton-Wentworth (RMHW) a request to prepare a four-part proposal for engineering services to implement site monitoring control programs for the Regional Landfill Site in Glanbrook and the Upper Ottawa Street Landfill Site. This proposal, entitled "1988 Annual Operation Monitoring Report - Glanbrook Regional Landfill Site", represents Item I as described in the RMHW's Request for Proposal (RFP).

After reviewing the RFP document, CRA assembled a Project Team to address the environmental monitoring program requested by the RMHW for the Glanbrook Regional Landfill Site. The structure of the Project Team thus reflects CRA's experience in developing, executing and overseeing environmental monitoring programs at both active and closed landfill sites throughout Ontario and North America. Individual members of the Project Team have been selected on the basis of experience in environmental monitoring at similar type of landfill site.

This proposal presents the objectives of the proposed environmental monitoring report; introduces the Project Team; discusses CRA's corporate qualifications for conducting the required work, discusses the anticipated project schedule and presents a complete cost estimate for preparation of the annual monitoring report for the Glanbrook site.

I.2.0 OBJECTIVES

Based on the review of the RFP document it is understood that the objectives of this study are as follows:

ITEM I

I.1) To collate the leachate and groundwater quality data as well as water level data in the area of the landfill site.

I.2) To review and summarize significant findings, provide conclusions, and make recommendations to ensure that landfilling operations continue in an environmentally acceptable manner, to the satisfaction of the Ministry of the Environment (MOE).

I.3) To review all 1988 monitoring data as well as the previous year annual monitoring report to ensure that the landfilling operations are in conformance with applicable environmental standards.

This proposal was developed bearing these objectives in mind.

I.3.0 PROPOSED WORK PLAN

CRA has prepared the following proposed work program to address the reporting requirements of the Regional Landfill Site in Glanbrook.

The Project Team is prepared to commence work on this project within two weeks of the Contract being awarded. CRA will collate and review all 1988 monitoring data available. Previous annual monitoring reports will be reviewed in order to define trends, if present and to summarize any significant findings. Discussions will be held with Regional staff in order to obtain information on matters related to the geology and hydrogeology of the site, the landfill site operations and on aspects of the Region's monitoring program. It is proposed that a draft report be prepared within three months of receipt of all available 1988 monitoring data. Conclusions and recommendations arising from interpretation of the monitoring data will be presented in the annual report, including recommendation for future monitoring requirements. The focus of the recommendations will be to ensure that landfilling operations continue in an environmentally acceptable manner, to the satisfaction of the Ministry of the Environment (MOE) and in conformance with applicable environmental standards.

Three copies of the annual report, in draft, will be submitted in draft for the RMHW to review and approve. Following an appropriate review period, the report will be finalized. Ten copies of the final report will be submitted.

I.4.0 MEETINGS

During the course of the preparation and presentation of the draft report it is proposed consideration be given to holding two meetings. The first meeting between the RMHW and CRA would be to discuss the overall work plan and matters related to the landfill site operation as well as a review of the Region's monitoring program.

The second meeting between the RMHW and CRA would be to discuss any significant findings as they relate to the Glanbrook Regional Landfill and to review the draft report.

It is anticipated that these meetings will be held in the RMHW offices in Hamilton, Ontario.

I.5.0 COST ESTIMATE

The total cost for conducting the program, as outlined in the RFP and detailed in our proposal, is $7530. The breakdown by activity is presented on Table I.5.1. Engineering fees are based on 1988 APEO chargeout rate. adjusted by four percent for 1989.

TABLE I.5.1

COST ESTIMATE

1988 ANNUAL MONITORING REPORT
GLANBROOK REGIONAL LANDFILL SITE

Activity	Item	Quality	Unit Cost	Cost
Project Preparation	Project Manager	8 hours	$60	$480
	Project Coordinator	8 hours	$40	$320
	Disbursements			$50
			Subtotal	$850
Data Collation and Review	Project Manager	4 hours	$60	$240
	Project Coordinator	40 hours	$40	$1,600
	Environmental Chemist	8 hours	$50	$400
	Disbursements			$100
			Subtotal	$2,340
Draft Report	Project Manager	4 hours	$60	$240
	Project Coordinator	40 hours	$40	$1,600
	Typing/Drafting	8 hours	$25	$200
	Disbursements			$300
			Subtotal	$2,340
Meetings	Project Manager	8 hours	$60	$480
	Disbursemenbts			$200
			Subtotal	$680
Final Report	Project Manager	2 hours	$60	$120
	Project Coordinator	20 hours	$40	$800
	Typing/Drafting	4 hours	$25	$100
	Disbursements			$300
			Subtotal	$1,320
			TOTAL	$7,530

I.6.0 PROJECT TEAM PERSONNEL

CRA has assembled a Project Team utilizing key professional and technical staff. The Project Team has the required experience and capabilities to successfully complete this project. Project Team members have been selected based upon their previous experience from work at similar landfill sites throughout Ontario and North America. A brief description of the duties and the qualifications of the Project Team members follows, while detailed curricula vitae are enclosed as Appendix A.

John M. Petrie, M. Sc. - Senior Hydrogeologist and Project Manager
Mr. Petrie, as project manager, will oversee and be actively involved in the direction of all aspects of this project, ensuring that high standards of technical merit are maintained throughout. Mr. Petrie will be briefed regularly during all activities by the project coordinator and will be available to attend all meetings. Responsibility for scheduling and budget control will be provided by Mr. Petrie.

As senior hydrogeologist, Mr. Petrie will also be responsible for the technical component of the study. Mr. Petrie's duties will include review of 1988 monitoring data and report preparation.

Mr. Petrie has 12 years of varied hydrogeological experience throughout Canada, the United States, northeast Africa and the Middle East. He is currently responsible for the hydrogeologic assessment of the Waterloo Regional Landfill as well as numerous industrial landfills. Mr. Petrie is also

involved with the monitoring of a number of closed landfills at Stouffville, West Gwillimbury, East Gwillimbury and Aurora.

Christine H. Galinski, M. Sc. - Project Hydrogeologist and Project Coordinator
Ms. Galinski, as project coordinator, will be responsible for the day to day management of the Project Team and will provide liaison between the RMHW and CRA. She will also be responsible for keeping the proper direction of the Project Team, and for keeping the project on schedule and within budget.

As project hydrogeologist, Ms. Galinski, will assist the senior hydrogeologist. She will be involved with data evaluation and report preparation. Ms. Galinski brings to the Project Team several years of experience in the environmental monitoring field and is currently responsible for monitoring at the Upper Ottawa Street Landfill Site and the Bayview Park Landfill Site in Burlington, Ontario.

Bruce Clegg, M. A. Sc. - Environmental Chemist
As environmental chemist,Mr. Clegg's primary responsibilities will include the review of the contract laboratories' quality assurance data and interpretation of analytical data. Mr. Clegg provides a technical overview of all analytical activities.

I.7.0 CORPORATE QUALIFICATIONS OF CRA

Conestoga-Rovers & Associates is a Canadian Engineering consulting firm with its head office located in Waterloo, Ontario and four branch offices located in Toronto, Ontario; Niagara Falls New York: Chicago, Illinois; and St. Paul, Minnesota. CRA employs approximately 180 professional and support staff. The professional staff include civil, chemical, biological, geological, mechanical and municipal engineers, hydrologists, geologists, hydrogeologists, chemists and planners. In addition to the full time staff, CRA has a number of specialists associated with the firm who have expertise in such areas as system modelling, statistical methods, soil chemistry and toxicology.

CRA enjoys an international reputation with regard to environmental engineering. CRA expertise includes the investigation, remediation and design of the following: sanitary landfills, hazardous waste landfills, sewage and water treatment plants, and chemical plant decommissioning as well as hydrogeological investigations and remediation. CRA also has extensive experience in environmental site audits, hazardous materials handling, inorganic and organic chemistry and analytical quality control and assurance.

CRA has been involved in various levels of both field and industrial monitoring and sampling since its inception in 1976. This sampling and monitoring experience has been developed through the investigation of landfill and industrial sites and the remediation of hazardous waste site. CRA's sampling experience has occurred in both

Canada and United States and has resulted in sampling programs and protocols that are state-of-the-art in the sampling industry. CRA continues to update all sampling methods to assure that the most representative sample is collected whether the sample is water, soil or air.

At the present time, CRA is involved in the monitoring at over fifteen Ontario landfill sites, industrial sites and hazardous waste remediation projects. In total, CRA has provided consulting engineering services for more than forty landfill sites across Ontario and has assisted various municipalities and industries across Canada with landfill engineering and hydrogeologic investigations.

Table I.7.1 presents a summary of related landfill investigations that CRA has been involved with in the past. The table includes descriptions of a number of projects which reflect relevant corporate expertise and experience in Ontario landfill monitoring, evaluation and engineering.

TABLE I.7.1

SUMMARY OF RELATED WORK EXPERIENCE

1988 ANNUAL MONITORING REPORT
GLANBROOK REGIONAL LANDFILL SITE

Bayview Park Landfill Site	On going engineering and environmental monitoring services for remediation works for the closed landfill site. Services include hydrogeologic investigation, design and implementation of leachate collection system, and design and implementation of surface drainage improvements.
Sarnia Landfill Site	Responsibilities include operation and management plan, a hydrogeologic investigation and impact assessment, design and construction of a retrofit periphery leachate collection system, ongoing environmental monitoring and leachate treatability study.
Keele Valley Landfill Site	Providing ongoing engineering services for the development and management of Metro Toronto's primary landfill site.
Waste Management of Canada	Hydrogeologic investigations, ongoing engineering management, and environmental monitoring of four Ontario landfills.
Town of Petrolia	Hydrogeologic investigation, ongoing site development and environmental monitoring of this landfill site.
Region of Waterloo Landfill	Hydrogeologic investigations, site development, leachate collection system design and comprehensive groundwater monitoring program for the landfill.

continued...

TABLE I.7.1

SUMMARY OF RELATED WORK EXPERIENCE

1988 ANNUAL MONITORING REPORT
GLANBROOK REGIONAL LANDFILL SITE

Canada Cement Lafarge	CRA has completed a full hydrogeologic assessment, implemented quarterly environmental monitoring and designed a plan of site operation and management to closure of the on-site landfill.
St. Mary's Landfill Site	Conducted full hydrogeologic assessment and ongoing environmental monitoring.
Dorchester Landfill Site	Conducted full hydrogeologic assessment and ongoing environmental monitoring.
Southwold Landfill Site	Conducted full hydrogeologic assessment and ongoing engineering management and environmental monitoring.
Upper Ottawa Street Landfill	Currently conducting the 1988 environmental monitoring program.

I.8.0 SUMMARY

It is felt that the proposed program will meet the requirements of the RFP. CRA has the necessary personnel and expertise required to successfully complete this project in a timely and cost-effective manner.

We would like to thank the RMHW for the opportunity of submitting this proposal and look forward to discussing it in the near future.

All of which is respectfully submitted,
CONESTOGA-ROVERS & ASSOCIATES

for John M. Petrie, M.Sc.

APPENDIX A

JOHN M. PETRIE, M.Sc.

EDUCATION:

1982-84	M.Sc (hydrogeology), University of Waterloo
1977-78	Diploma in Groundwater Development, Hebrew University of Jerusalem, Israel
1971-74	M.Sc (geology), University of Canterbury, New Zealand
1967-69	B.Sc (geology), University of Canterbury, New Zealand

EMPLOYMENT:

1984-Present	Senior Hydrogeologist Conestoga-Rovers & Associates Limited
1982	Groundwater Geologist Piteau and Associates
1981	Groundwater Geologist Pacific Hydrology Consultants
1978-81	Project Groundwater Geologist Associated Engineering Services Limited
1975-77	Groundwater Geologist B.C. Ministry of the Environment
1974	Mine Geologist Consolidated Churchill Copper Corporation, B.C.
1970-71	Exploration Geologist Layton and Associates Ltd. (N.Z.)

AFFILIATIONS:

Member - International Association of Hydrogeologists

Member - Association of Groundwater Scientists and Engineers

PROFILE OF ACTIVITIES:

- Exploration geology including geochemical and geological mapping of hard rock and unconsolidated formations

PROFILE OF ACTIVITIES: (continued)

- Structural mapping and tectonic interpretation of fold mountain terraines
- Mine geology including grade control, calculations of ore reserves and design of stopes
- Evaluation of hydrogeologic, hydrologic and climate data for regional water balance studies and water supply evaluations
- Evaluation of groundwater potential for irrigation and municipal water supplies
- Contract preparation, well design, supervision of drilling and pumping tests, along with final report preparation, for irrigation and municipal water supplies
- Investigations of groundwater quality problems
- Evaluation of groundwater impacts associated with landfilling operations and hazardous waste sites
- Evaluation of the hydraulic response of clays in layered aquifer systems
- Installation of observation wells, piezometers and multilevel piezometers into uncosolidated materials and bedrock
- Design and performance evaluation of groundwater remediation systems utilizing purge wells
- Hydrogeologic evaluation of remedial alternatives at waste disposal sites
- Evaluation of groundwater monitoring programmes

PUBLICATIONS:

"Well Design and Aquifer Analysis at Fairview Heights Irrigation District", Cawston, B.C. Presented to the Geological Association of Canada Annual Meeting, Vancouver, 1977

"Evolution of Brackish Groundwaters, Saanich Peninsula, Vancouver Island, British Columbia". Presented by senior author to the Geological Association of Canada Annual Meeting, Toronto, 1978 (with A.P. Kohut)

CHRISTINE H. GALINSKI, M.Sc.

EDUCATION:

B.Sc. University of Windsor, Honours Geology and Biology, 1980

M.Sc. University of Windsor, Geology, 1983

EMPLOYMENT:

1986 - Present Project Hydrogeologist, Conestoga-Rovers & Associates Limited

1984-1986 Hydrogeologist,
Monenco Limited, Calgary, Alberta

1980-1983 Teaching Assistant
University of Windsor

1981-1982 Geologist
Eldorado Nuclear Ltd., Ottawa, Ontario

PROFILE OF PROFESSIONAL ACTIVITIES

- Project Coordinator regarding hazardous waste site (former coal gasification plant) at Woodstock, Ontario on behalf of Reeves Realty Ltd. and the City of Woodstock.

- Assisted in development and execution of site investigation and monitoring programs regarding possible polyaromatic hydrocarbon (PAH) contamination in the vicinity of a municipal well field on behalf of the City of Waterloo and the Regional Municipality of Waterloo.

- Assisted in development and excecution of a study to identify a possible source of trichloroethylene (TCE) contamination detected in industrial and municipal supply wells on behalf of the Regional Municipality of Waterloo.

- Assisted in development of site remediation and monitoring programmes for polychlorinated biphenyl (PCB) contaminated groundwater at Pottersburg Creek, London, Ontario on behalf of the Ministry of the Environment.

PROFILE OF PROFESSIONAL ACTIVITIES:

- Conducted and interpreted electromagnetic surveys to deliniate areas of contaminated groundwater on behalf of Gulf Canada Resources Incorporated and CIL Carseland Works in Alberta, Domtar Chemicals Group, Sifto Salt Division in Saskatchewan, and numerous sites in the United States (Owners Confidential).

- Investigated existing coal ash lagoon sites regarding the future ash and leachate quality, and the impact of the ash lagoons on downgradient domestic water wells on behalf of TransAlta Utilities Corporation, Wabamun, Alberta.

- Evaluated and defined suspected soil salinity problems in the vicinity of a pipeline field station on behalf of Gulf Canada Resources, Inc., Stettler, Alberta.

- Assisted in development and execution of site remediation and monitoring prgorams for subsurface brine migration at a salt mine at Unity, Saskatchewan, on behalf of Domtar Chemicals Group, Sifto Salt Division.

- Evaluated the stratigraphy and groundwater resources along a designated major cross-section in southern Alberta as part of a provincial drought-proofing program on behalf of Alberta Environment.

PUBLICATIONS:

- "Selected Trace Metal Concentrations in Groundwater Steams and Soils in Essex County, Ontario", M.Sc. Thesis, University of Windsor, 1983.

PROFILE OF PROFESSIONAL ACTIVITIES:

- Project Coordinator, QA/QC Officer
  Generator (PRP) Group
  Coordination of a Remedial Investigation/Feasibility Study for a former PCB storage and processing facility (Yellow Water Road Site), Baldwin, Florida

- Project Coordinator
  City of Sarnia, Ontario
  Design and coordination of a monitoring program for polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans at a site in Sarnia, Ontario

- Project Coordinator
  Salsbury Laboratories Inc., Charles City, Iowa
  Design and coordination of a bench scale testing program for solidification of liquid wastes contained within a hazardous waste impoundment

- Project Coordinator
  Region of Waterloo
  Design and coordination of a bench-scale program to evaluate the efficacy of treating landfill leachate at a local secondary water pollution control plant

- Project Coordinator
  Kraft Inc.
  Design and coordination of a bench-scale investigation to determine the effect of varying hydraulic head on migration rates of a PCB/trichloroethylene solution through a solid concrete monolith

- Project Coordinator
  Sevenson Containment Corporation/Dayton Power and Light, Aberdeen, Ohio
  An oily waste lagoon study was undertaken to physically and chemically characterize sludge contained within an on-site impoundment located at the J.M. Stuart power generating facility. In order to determine the effectiveness of common admixtures to solidify/stabilize waste sludge, a bench-scale testing program was performed concurrently with the lagoon investigation

- Quality Control Officer/Technical Advisor
  Region of Ottawa-Carleton
  Professional activities for this project included:
  subcontractor laboratory audits; technical review and assessment of an historical data base; and review of data generated during the active investigative phase of the project

PROFILE OF PROFESSIONAL ACTIVITIES:

- Quality Control Officer/Project Chemist
  Velsicol Chemical Corporation
  Professional responsibilities include evaluation of historical data for selection of indicator parameters; analytical data assessment; and liaison with project laboratory in support of a Remedial Investigation/Feasibility Study at Hardeman County, Tennessee

- Quality Control Officer
  Generator (PRP) Group
  The primary mandate for this project was to evaluate and assess analytical data generated during a Remedial Investigation conducted at the North Hollywood Dump, Memphis, Tennessee

- Quality Control Officer
  Generator (PRP) Group
  Professional activities for this project included subcontractor laboratory audits and QAPP review in support of a Supplemental Remedial Investigation/Feasibility Study for Wauconda Sand and Gravel, Wauconda, Illinois

- Quality Control Officer
  Chem-Dyne Site Trust
  Professional responsibilities included the following:
  1. direct liaison with the project laboratory in preparation of an analytical QAPP
  2. laboratory audit and inspection of the selected project lab for technical expertise and ability to follow approved protocols as outlined in the QAPP, and
  3. data review and assessment.

- Project Manager
  Sevenson Containment Corporation/Mineral Research and Development Corporation
  This project demonstrated the feasibility of solidification/stabilization of a toxic heavy metal sludge with Portland cement and common admixtures. In addition, an optimal design mix ratio was determined in anticipation of final secure closure of the impoundment

- Quality Control Officer
  FMC
  Professional responsibilities included analytical data assessment and evaluation in support of a Remedial Investigation and RCRA monitoring program conducted at FMC's Middleport, New York plant site

- Project Manager
  CRA Analytical Services
  This position involves:
  1. Management of CRA's wet chemical analytical services, and
  2. Technical oversight of the facility

PROFILE OF PROFESSIONAL ACTIVITIES:

- Project Manager
  Client Confidential
  Technical supervision and report preparation for a mercury site assessment monitoring program

- Technical Advisor
  Stratford Public Utilities Commission
  The three-fold responsibilities for this project included:
  1. monitoring and water quality assessment of various groundwater sources
  2. bench-scale studies of iron sequestration via sodium silicate addition, and
  3. assistance in design and implementation of an iron treatment system

- Technical Advisor
  Village of Embro
  Professional activities included chemical characterization and assessment of a potable water supply in anticipation of chemical treatment for iron

- Laboratory Manager and QA/QC Officer
  Arctic Laboratories Limited
  This position involved supervision of the laboratory facility, personnel management, implementation and supervision of standardized QA/QC procedures and final data review and approval

PROFESSIONAL AFFILIATIONS:

- Member - American Chemical Society

PUBLICATIONS:

- "Microbial Activity On Bituminized Radioactive Waste", Radioactive Waste Management and The Nuclear Fuel Cycle, March 1985 (with L.P. Buckley and W.K. Oldham)

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